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Seasonal Abundance and Diversity of Benthos in a Southern Illinois Swamp

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Abstract. The benthic invertebrate fauna of a portion of the Pine Hills Swamp exhibited extreme seasonal fluctuations in both abundance and diversity. The dominant benthos was characterized by organisms tolerant of high concentrations of organic material and low oxygen levels, as well as possessing aestivation capabilities or life cycle adaptations to overcome severe midsummer environmental conditions.

Numerous studies of the Pine Hills area of Illinois have been made pertaining to the flora (Mohlenbrock, 1959 ; Mohlenbrock et al., 1961 ; Ashby and Kelting, 1963 ; Weik and Mohlenbrock, 1963 ; Mohlenbrock and Engh, 1964; Mohlenbrock and Voigt, 1965 ; Brandoni and Parsons, 1966) . Additional surveys of the fish (Gunning and Lewis, 1955) , herpetofauna (Cagle, 1942 ; Rossman, 1960) , and mammals (Layne, 1958 ; Klimstra, 1969 ; Krull and Bryant, 1972) have been accomplished. No studies pertaining to the aquatic invertebrates of Pine Hills have been published.

Like the marsh, the swamp contains a richness of life too often little appreciated and not understood by man. Smith (1966) states that swamps, "embrace a richness and diversity of life that is hard to equal in other temperate communities". Although a few studies on the dynamics of aquatic invertebrates in swamp communities have been conducted (Allee, 1911 ; Kenk, 1949 ; Wharton, 1970) , much research is still needed.

DESCRIPTION OF THE STUDY AREA

Pine Hills Swamp is located on the Mississippi River floodplain in Union County just north of Wolf Lake, Illinois. The area encompasses a natural swamp community essentially unaltered by man. Specifically, Otter Pond, inside the Pine Hills Field Station, was studied. The main portion of Otter Pond is an open water area approximately 250 m long and 25 m wide, surrounded by dense emergent and woody vegetation. The bottom is soft mud, generally devoid of vegetation.

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METHODS

Quantitative collections of benthic invertebrates were made at weekly intervals from April through October, 1969. The collections (four from each area) were from two general areas on the east and west sides of the pond, adjacent to the emergent vegetation, but in areas devoid of bottom vegetation. An Ekman dredge (15 x 15 cm.) was used to collect the bottom mud and it was sifted through a standard sieve (U. S. Standard Sieve Series No. 16) . All benthic invertebrates separated from the debris were identified and counted in the laboratory. Identification to the lowest practical taxon was made using keys by Pennak (1953) .

RESULTS AND DISCUSSION

The abundance and diversity of benthos encountered at Pine Hills is presented in Table 1. The most pronounced finding of this study was the paucity of animal organisms in the bottom mud in comparison to that encountered in areas supporting good growths of submerged and floating aquatic vegetation. Nevertheless, several orders and families of benthic invertebrates were collected.

Past investigators have observed spring and late fall maxima, with winter and late summer minima in both the abundance and diversity of benthic invertebrates (Peterson, 1926 ; Dineen, 1953 ; Anderson and Hooper, 1956) . This phenomenon of seasonal succession holds, both in regard to succession of species and to the number of individuals of a species, for the benthos of Pine Hills Swamp. The magnitude of the fluctuation was extremely pronounced. From a total of 1,597 invertebrates per sq m in April there was a decline to only 11 organisms per sq m by August. From the August low the number rose to 812 organisms per sq m in October.

The most abundant Spring organisms were Sphaeriidae, Oligochaeta, and pulmonate snails. No group dominated mid-summer collections. The Fall population was dominated by Tendipedidae, Culicidae, Sphaeriidae, Oligochaeta, and pulmonate snails. Two generalizations can be made concerning the dominant Spring and Fall benthos. First, they are characteristic of waters with high organic matter such as a swamp or polluted stream (Keup et al., 1966) . Second, some of the dominant organisms in both the Spring and Fall collections, i.e. Sphaeriidae, Oligochaeta, and pulmonate snails, are capable of aestivation.

The extreme mid-summer environmental conditions of high water temperatures (sometimes above 30°C) and low oxygen concentrates (often below 3 p.p.m.) require special adaptations. Insects possess two major types of adaptation to withstand mid-summer extremes. First, many insects have specialized life cycles so they are emergent adults or in a dormant stage during the mid-summer environmental stress. Second, many insects have the capability of utilizing atmospheric oxygen. Aestivation is the means used by annelids and molluscs. It is likely that

deep burrowing coupled with aestivation enable mid-summer survival

TABLE 1. Benthos collected at Pine Hills Swamp, April-October, 1969.

	Number of organisms per square meter of bottom							Relative percentage of the month's sample						
Organisms	A	M	J	J	A	S	O	A	M	J	J	A	S	O
Annelids	418	87	22	22	....	....	108	26.2	12.1	6.0	22.2	....	....	13.3
Oligochaeta	395	71	11	11	....	....	108	22.8	9.9	3.0	11.1	....	....	13.3
Glossiphonidae	20	15	....	....	....	....	....	0.2	2.1	....	....	....	....	....
Erpodellidae	3	....	11	11	....	....	....	1.3	....	3.0	11.1	....	....	....
Crustaceans	103	21	....	....	....	....	....	6.5	2.9	....	....	....	....	....
Asellus sp.	7	2	....	....	....	....	....	0.4	0.3	....	....	....	....	....
Hyallela azteca	96	19	....	....	....	....	....	6.0	2.7	....	....	....	....	....
Insects														
Odonata	30	4	....	....	....	32	11	1.9	0.6	....	....	....	15.8	1.3
Erythemis sp.	22	....	....	....	....	11	11	1.4	....	....	....	....	5.3	1.3
Pachydiplax longipennis	....	4	....	....	....	21	....	....	0.6	....	....	....	10.5	....
Ephemeroptera	5	....	....	....	....	....	....	0.3	....	....	....	....	....	....
Siphlonurus sp.	5	....	....	....	....	....	....	0.3	....	....	....	....	....	....
Hemiptera	7	8	3	22	....	....	11	0.4	1.2	0.9	22.2	....	....	1.3
Notonectidae	....	....	....	11	....	....	....	....	....	....	11.1	....	....	....
Plea striola	5	2	....	....	....	....	....	0.3	0.3	....	....	....	....	....
Pelocoris sp.	1	2	....	....	....	....	....	0.1	0.3	....	....	....	....	....
Hespercorixa sp.	....	4	3	11	....	....	11	....	0.6	0.9	11.1	....	....	1.3
Coleoptera	11	4	....	11	11	11	....	0.7	0.6	....	11.1	100.	5.3	....
Bidessus sp.	1	....	....	....	....	....	....	0.1	....	....	....	....	....	....
Suphisellus sp.	....	2	....	....	....	....	....	....	0.3	....	....	....	....	....
Agabus sp.	3	....	....	....	....	....	....	0.2	....	....	....	....	....	....
Ilybius sp.	....	....	....	....	11	....	....	....	....	....	....	100.	....	....
Helodidae	....	2	....	....	....	....	....	....	0.3	....	....	....	....	....
Noteridae	1	....	....	....	....	....	....	0.1	....	....	....	....	....	....
Diptera	156	19	....	....	....	....	498	9.8	2.7	....	....	....	....	62.8
Tendipedidae	120	19	....	....	....	....	325	7.6	2.7	....	....	....	....	40.0
Ceratopogonidae	24	....	....	....	....	....	....	1.5	....	....	....	....	....	....
Chaoborus sp.	8	....	....	....	....	....	184	0.5	....	....	....	....	....	22.7
Chrysops sp.	3	....	....	....	....	....	....	0.2	....	....	....	....	....	....
Lepidoptera	1	....	....	....	....	....	11	0.1	....	....	....	....	....	1.3
Nymphulinae	1	....	....	....	....	....	11	0.1	....	....	....	....	....	1.3
Homoptera	....	....	....	....	....	....	22	....	....	....	....	....	....	2.7
Fulgoridae*	....	....	....	....	....	....	22	....	....	....	....	....	....	2.7
Arachnids	1	....	....	....	....	....	....	0.1	....	....	....	....	....	....
Araneae*	1	....	....	....	....	....	....	0.1	....	....	....	....	....	....
Molluscs	864	574	338	43	....	162	140	54.2	79.9	92.4	44.4	....	79.0	17.4
Physa sp.	60	17	105	32	....	21	21	10.9	12.7	42.9	33.3	....	15.8	4.1
Gyraulus sp.	100	67	43	....	....	11	11	6.3	9.3	11.8	....	....	5.3	1.3
Helisoma sp.	5	4	3	....	....	....	....	0.4	0.6	0.9	....	....	....	....
Lymnaea sp.	7	2	5	....	....	....	....	0.5	0.3	1.4	....	....	....	....
Musculium sp.	691	483	181	11	....	130	108	43.3	67.2	49.5	11.1	....	63.2	13.3
Total	1597	717	366	98	11	205	812							

*Terrestrial representatives.

and accounts for their pronounced absence from Ekman dredge collections. No specific adaptations enabling crustacean survival can be described.

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